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XB3 ITEMS WITH A POSITIVE DEMAND LEVEL AND A REORDER POINT OF ZERO

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AFLMA FINAL REPORT LS199718901

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Executive Summary

PROBLEM:

There are situations when Air Force retail supply systems, the Standard Base Supply System (SBSS) and the Wholesale and Retail Receiving/Shipping System (D035K), compute a zero reorder point for consumable (XB3) items with positive demand levels. This might cause preventable backorders, including mission capable (MICAP) and awaiting parts (AWP) due-outs.

OBJECTIVE:

Determine the number and mission impact of items with a reorder point of zero. Compare the cost to increase the reorder point to the benefit of reduced backorders.

ANALYSIS/RESULTS:

We analyzed data on XB3 items with a positive demand level and a reorder point of zero from both base-level (SBSS) and depot-level (D035K) accounts. Our results indicate a change to the current SBSS policy can reduce due-outs on mission essential (MICAP causers) XB3 items by as many as 1,730 annually (Air Force-wide) and reduce Defense Logistics Agency (DLA) surcharges by approximately $31K per year. The cost of such a policy change is a one-time inventory investment of $1.1M. A somewhat different approach to changing D035K policy will reduce backorders for XB3 items in depot retail accounts by almost 1,740 annually and reduce DLA surcharges by approximately $24K per year at an estimated one-time inventory investment of $219K.

CONCLUSIONS:

1. OCONUS bases can reduce their number of backorders by ensuring eligible item records are assigned a C-factor of two.

2. By increasing the reorder point from zero to one for selected (non-retention, non-bench stock) XB3 items, which have a demand level greater than two and a mission impact code of 1, **Standard Base Supply Systems at 60 CONUS bases** (01 accounts only) can reduce approximately 1,730 MICAP backorders annually at a net present value cost of approximately $896K, or approximately $15K per base. We believe this cost is too high when compared to the expected benefits.

3. **Depot retail systems (D035K)** can reduce nearly 1,740 backorders annually by increasing the reorder point from zero to one on XB3 items which have an average customer order size (lot size) greater than one, a daily demand rate greater than 0.010 and a unit price less than or equal to $1,000. The 7-year net present value cost (expected increase in base operations and maintenance costs) for implementation at all Air Logistics Centers is estimated at $63K.

RECOMMENDATIONS:

1. OCONUS bases ensure eligible items are assigned a C-factor of 2.
   (REF: AFMAN 23-2110, Volume II, Part Two, Chapter 19, Paragraph 19.12.4.2.)
   OPR: HQ USAFE/LGS and HQ PACAF/LGS

2. Continue to use the current SBSS reorder point formula.

3. Program D035K to increase the reorder point from zero to one (and increase the demand level by one) on XB3 items with a lot size greater than 1, daily demand rate greater than 0.010, and unit price less than or equal to $1000.
   OPR: HQ AFMC/LGS

TABLE OF CONTENTS

PAGE

EXECUTIVE SUMMARY i

LIST OF TABLES iv

CHAPTERS

1 INTRODUCTION 1
BACKGROUND 1
PROBLEM 1
STUDY OBJECTIVES 1

2 ANALYSIS 3
OVERVIEW 3
STANDARD BASE SUPPLY SYSTEM METHODOLOGY 3
WHOLESALE AND RETAIL RECEIVING/SHIPPING SYSTEM (D035K) 13

3 CONCLUSIONS AND RECOMMENDATIONS 21
CONCLUSIONS 21
RECOMMENDATIONS 21

APPENDICES

A AFLMA COMPROMISE PROPOSAL 22

B ANALYSIS METHODOLOGY 23

LIST OF TABLES

TABLES
PAGE

2-1. Items with DL=1 and Reorder Point = 0 (1997) 3

2-2. Items with DL=1 and Reorder Point = 0 (1998) 3

2-3. Comparison of Reduction in Annual Backorders for Non-Retention Items with a ROP=0 (1997) 4

2-4. Comparison of Reduction in Annual Backorders for Non-Retention Items with a ROP=0 (1998) 4

2-5. Comparison of Benefits Versus Cost to Increase ROP from 0 to 1 for Non Retention Items with DL>1(1997) 6

2-6. Comparison of Benefits versus Cost to Increase ROP from 0 to 1 for Non-Retention Items with DL>1 (1998) 7

2-7. Non-Retention Items with ROP=0, D/L>1 and MIC=1 (1998) 8

2-8. Non-Retention, Non-Bench Stock Items with ROP=0, DL>1 and MIC=1 (1998) 9

2-9. Non-Retention, Non-Bench Stock Items with ROP=0, MIC=1 and DL>2 (1998) 10

2-10. Net Present Value (NPV) Comparison of All Cost (Separate) 11

2-11. NPV Comparison of all Costs (Combined) 11

2-12. NPV Comparison of Total Costs versus O&M Costs only 12

2-13. NPV Comparison of $17.72 DLA Surcharge versus $17.73 DLA Surcharge 12

2-14. Comparison of Items with ROP=0 and LS>=1 to Items with ROP=0 and LS>1 at WR-ALC 14

2-15. Comparison of Items with Reorder Point=0 and LS>=1 to Items with ROP=0 and LS>1 at OC-ALC 15

2-16. Cost Filter for WR-ALC for Items with LS>1 15

2-17. Cost Filter for OC-ALC for Items with LS>1 16

2-18. Comparison of DDRs and LS (WR-ALC) 17

2-19. Comparison of DDRs and LS (OC-ALC) 17

2-20. Comparison of NPV (All Costs) WR-ALC and OC-ALC 18

2-21. Comparison of NPV (All Costs), AFMC Totals 18

2-22. NPV Comparison of Total Costs versus O&M Costs only...19

CHAPTER 1

INTRODUCTION

BACKGROUND

A reorder point, also known as reorder level, is a level that indicates when an item must be replenished (requisitioned). When an item's serviceable on-hand balance reaches or goes below its reorder point, a stock replenishment requisition is created for the difference between the on-hand balance and the demand level. The amount of stock left on hand is expected to satisfy demands during the replenishment period. If the reorder point for an item is set at zero, this means the item's serviceable balance will reach zero before a replenishment order is generated. For items with a reorder point of zero, if a demand is placed before the replenishment order is received, a backorder is created. An item's reorder point consists of the safety level added to the order and ship time quantity. The safety level is the standard deviation multiplied by a C-factor. A C-factor of 1 theoretically fills 84 percent of the demands during the reorder time and a C-factor of 2 fills 97 percent.

Questions arose during the 1997 Air Force Stockage Policy Working Group meeting concerning why a reorder point of zero was computed for some items with a positive demand level. HQ USAF/ILS tasked the AFLMA to determine if calculating a positive reorder point was cost-beneficial.

PROBLEM STATEMENT

Air Force retail supply systems (the Standard Base Supply System (SBSS) and the Wholesale and Retail Receiving/Shipping System (D035K)) compute a zero reorder point for some consumable (XB3) items.

STUDY OBJECTIVES

Determine the number and mission impact of items with a reorder point of zero. Compare the cost to increase the reorder point to the benefit of reduced backorders.

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CHAPTER 2

ANALYSIS

OVERVIEW

This chapter is organized into two parts. Part one identifies impacts of increasing the reorder point from zero to one in the Standard Base Supply System. Part two focuses on results of increasing the reorder point from zero to one in the Wholesale and Retail Receiving/Shipping System. The technical details of how we analyzed the data are in Appendix B, Analysis Methodology.

STANDARD BASE SUPPLY SYSTEM

Using data from Moody, Dover, Minot, Pope, Randolph and Robins Air Force Bases, and Kadena and Spangdahlem Air Bases, we extracted item record data from March 1997 and March 1998 (from the 01 account at each base). We identified XB3 items with a positive demand level and a reorder point of zero. The results are listed in Tables 2-1 and 2-2.

1997

Base	Items with DL>0	Items with DL>0 & ROP=0	Items with DL=1 & ROP=0
Dover	10,666	1,371	99
Moody	11,773	3,110	175
Minot	6,297	513	32
Pope	8,665	554	59
Randolph	7,396	362	17
Robins	8,342	1,346	63
Kadena	24,398	842	27
Spangdahlem	9,968	27	0

Table 2-1. Items with Positive DL and ROP=0 (1997)

1998

Base	Items with DL>0	Items with DL>0 & ROP=0	Items with DL=1 & ROP=0
Dover	11,273	1,829	483
Moody	10,798	2,475	656
Minot	6,224	600	137
Pope	8,308	674	215
Randolph	7,497	1,520	358
Robins	8,619	495	161
Kadena	20,763	127	62
Spangdahlem	11,255	55	23

Table 2-2. Items with Positive DL and ROP=0 (1998)

Of the 10,666 items with a positive demand level at Dover AFB (1997), 1,371 had a reorder point of 0 (99 of which had a demand level of 1). Note the relative difference between OCONUS and CONUS in the number of items with a reorder point of zero. There are two reasons OCONUS bases have proportionally fewer items with a reorder point of zero. First, the reorder point is a function of the order and ship time and OCONUS bases have longer order and ship times. The longer the order and ship time the larger the reorder point. Second, OCONUS bases are authorized a C-factor of 2 for specific types of items. Larger C-factors mean larger reorder points. If you note the decrease in items with a demand level greater than zero and a reorder point equal to zero at Kadena from 1997 to 1998, you can see the impact of higher C-factors. During this period, Kadena increased the C-factor from 1 to 2 on numerous items. We discuss this correlation further on page 7.

We omitted retention items (items with a date of last demand > 365 days) from future analysis because these items are not replenished. Using data from 1997 and 1998, we forecasted the number of annual backorders that could be reduced if items had positive reorder points. We measured the reduction in annual backorders for non-retention items with a reorder point equal to zero and demand level equal to one. We also measured the annual backorders for items with a reorder point of zero and a demand level *greater than* one (see Tables 2-3 and 2-4). We computed the One-Time Inventory Cost by totaling the unit cost of all items for which we would increase the reorder point and demand level.

Base	B/O Reduced (Demand Level=1)	One-Time Inventory Cost	B/O Reduced (Demand Level>1)	One-Time Inventory Cost
Dover	8	$120.6K	140	$249.5K
Moody	6	$78.6K	201	$190.1K
Minot	2	$48.1K	72	$124.2K
Pope	7	$88.2K	75	$174.2K
Randolph	1	$12.7K	51	$72.0K
Robins	4	$62.3K	104	$126.0K
Kadena	2	$23.5K	97	$134.7K
Spangdahlem	0	-	5	$65.4K

Table 2-3. Comparison of Reduction in Annual Backorders for Non-Retention Items with a ROP=0 (1997 data)

Base	B/O Reduced (Demand Level=1)	One-Time Inventory Cost	B/O Reduced (Demand Level>1)	One-Time Inventory Cost
Dover	42	$438.2K	130	$95.4K
Moody	40	$351.5K	155	$101.0K
Minot	14	$205.8K	66	$150.4K
Pope	26	$271.7K	80	$76.5K
Randolph	11	$85.4K	99	$54.9K
Robins	18	$183.6K	58	$28.7K
Kadena	9	$93.4K	12	$32.6K
Spangdahlem	3	$54.5K	6	$3.3K

Table 2-4. Comparison of Reduction in Annual Backorders for Non-Retention Items with a ROP=0 (1998 data)

As expected, the number of demands on items with a demand level equal to one is so small that there are relatively few backorders that can be prevented by increasing the reorder point for these items. Therefore, we excluded items with a demand level equal to one from the rest of our analysis of SBSS data. There seems little benefit, at a very high cost (e.g., $120.6K to reduce 8 backorders at Dover in 1997), to increasing the reorder point to try to reduce so relatively few backorders.

Results in Tables 2-3 and 2-4 clearly show the potential to reduce backorders are much better for items with a demand level greater than one. Since there is a possibility of reducing backorders (at least at seven of the eight bases) we wanted to determine the best method of increasing the reorder point. We tested two methods.

Method 1 increases the reorder point from zero to one on items without changing the demand level. This method would result in additional orders placed over a year's time (since it reduces the order quantity by 1). As an example, consider an item with a demand level of three and a reorder point of zero. When a replenishment order is placed, the quantity is for three. That is, an order is placed after all three serviceable items have been issued and the serviceable balance reduced to zero. If we raise the reorder point from zero to one, a stock replenishment order for two will be placed when the serviceable balance reaches one. The forecasted costs involved in implementing such a change are:

1) Additional orders created by increasing the reorder point from zero to one incur a per-order cost (processing, etc.) from the source. Because our items are sourced from different agencies (DLA, GSA, Local Purchase, etc.) we used the $17.73 per-order surcharge from the Defense Logistics Agency (DLA) as a typical order cost. (We found 89 to 95 percent of the parts qualifying to increase the reorder point were in fact DLA managed parts.) We arrived at our estimate of the *Order Cost (DLA)* by multiplying the increase in requisitions by $17.73. To determine the increase in requisitions we subtracted the number of prevented backorders (which generate requisitions) from the estimated number of additional replenishment requisitions.

2) There are three base-level costs. One is the base *ordering cost*, which the Air Force computes as $5.20 per order. We included the base *ordering cost* as an additional annual cost for the net increase in requisitions. There will also be a one-time increase in inventory cost (referred to as *One-Time Inventory Cost*). Average inventory will increase by one-half of a unit for those items increasing their reorder point. Average inventory is the order quantity divided by 2 plus the safety level. Reducing the order quantity by one reduces average inventory by one-half. Increasing the reorder point to one effectively increases the safety level by one and therefore total average inventory by one-half. Therefore, we estimated the increase in inventory cost by multiplying the item's unit price by 0.50. Finally, there is an annual *holding cost*, which is 15 percent of the increase in inventory.

Method 2 increases the demand level and the reorder point by one. This doesn't create additional orders (the order quantity does not change), but will require a one-time expenditure of funds to purchase stock for an increase in demand levels. We estimated this cost (*One-Time Inventory Cost*) by totaling the unit cost of all items for which we increase the demand level. Using the

example of an item with a demand level of three and a reorder point of zero, we increased the demand level to four and increased the reorder point to one. When the new reorder point of one is reached, the same quantity is ordered (three) as when the demand level was three and the reorder point was zero. Since there is no change in the order frequency, there is no increase in annual *ordering cost* (surcharge) for this policy. However, there is a **reduction** in base *ordering cost* and DLA surcharge costs due to the decrease in backorders. We calculated these savings using the $5.20 cost per order and the DLA surcharge. Finally, there is an annual *holding cost*—15 percent of the increase in inventory. The results of comparing the additional costs, or savings, of implementing each method are in Tables 2-5 (1997 data) and 2-6 (1998 data).

Please note throughout the following tables we exclusively used *Method 1* as a tool to gauge the effectiveness of the filters applied. For the most part *Method 2* experiences the same trend in results as *Method 1*. After summarizing the results of the last filter (Table 2-9), we compared *Method 1* costs to *Method 2* costs using a Net Present Value computation (results displayed in tables 2-10 through 2-13) to determine which method is more cost effective.

			Method 1				***Method 2***			
				Annual Costs				**Annual Costs/Savings**		
Base	**Items**	**B/O Redu.**	**One-Time Inv. Costs(1)**	**Order Cost (DLA)(2)**	**Hold Cost(3)**	**Order Cost (Base)(4)**	**One-Time Inv. Cost(5)**	**Hold Cost(6)**	**Order Cost (Base) Savings(7)**	**DLA Surcharge Savings(8)**
Dover	966	140	$124.7K	$14.2K	$18.7K	$4.2K	$249.5K	$37.4K	($0.7K)	($2.5K)
Moody	1993	201	$95.0K	$29.2K	$14.3K	$8.6K	$190.1K	$28.5K	($1.0K)	($3.6K)
Minot	481	72	$62.1K	$6.2K	$9.3K	$1.8K	$124.2K	$18.6K	($0.4K)	($1.3K)
Pope	495	75	$87.1K	$5.7K	$13.1K	$1.7K	$174.2K	$26.1K	($0.4K)	($1.3K)
Rand	344	51	$36.0K	$4.1K	$5.4K	$1.2K	$72.0K	$10.8K	($0.3K)	($0.9K)
Robins	986	104	$63.0K	$13.9K	$9.4K	$4.1K	$126.0K	$18.9K	($0.5K)	($1.8K)
Kad.	599	97	$67.3K	$7.7K	$10.1K	$2.3K	$134.7K	$20.2K	($0.5K)	($1.7K)
Spang.	27	5	$32.7K	$0.2K	$4.9K	$50	$65.4K	$9.8K	($25)	($90)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Base order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-5. Comparison of Benefits versus Cost to Increase ROP from 0 to 1 for Non-Retention Items with DL>1 (1997)

			Method 1				***Method 2***			
				Annual Costs				**Annual Costs/Savings**		
Base	**Items**	**B/O Redu.**	**One-Time Inv. Costs(1)**	**Order Cost (DLA)(2)**	**Hold Cost(3)**	**Order Cost (Base)(4)**	**One-Time Inv. Cost(5)**	**Hold Cost(6)**	**Order Cost (Base) Savings(7)**	**DLA Surcharge Savings(8)**
Dover	1030	130	$47.7K	$15.8K	$7.2K	$4.6K	$95.4K	$14.3K	($0.7K)	($2.3K)
Moody	1537	155	$50.5K	$24.5K	$7.6K	$7.2K	$101.0K	$15.1K	($0.8K)	($2.7K)
Minot	463	66	$75.2K	$6.6K	$11.3K	$2.0K	$150.4K	$22.6K	($0.3K)	($1.2K)
Pope	459	80	$38.3K	$6.6K	$5.7K	$1.9K	$76.5K	$11.5K	($0.4K)	($1.4K)
Rand	908	99	$27.5K	$14.6K	$4.1K	$4.3K	$54.9K	$8.2K	($0.5K)	($1.8K)
Robins	334	58	$14.3K	$4.9K	$2. 2K	$1.4K	$28.7K	$4.3K	($0.3K)	($1.0K)
Kad.	65	12	$16.3K	$0.4K	$2.4K	$0.1K	$32.6K	$4.9K	($0.1K)	($0.2K)
Spang.	32	6	$1.7K	$0.4K	$0.2K	$0.1K	$3.3K	$0.5K	($30)	($100)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Base order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-6. Comparison of Benefits versus Cost to Increase ROP from 0 to 1 for Non-Retention Items with DL>1 (1998)

There are 1,030 items at Dover AFB (1998) with a reorder point equal to zero and a demand level greater than one. Using *Method 1*, increasing the reorder point to one would reduce backorders by 130, would cost $47.7K to increase average inventory and $15.8K a year in DLA surcharges, plus $7.2K in annual holding cost (0.15*$47.7K) and $4.6K in increased (base) order cost at Dover to process requisitions.

We included the comparison from 1997 and 1998 to further illustrate the impact of C-factors. Taking note of the information from Kadena, you can see a sharp decline in number of items (599 to 65) with a reorder point of zero and backorders reduced (97 to 12). We attribute these declines to an increase in items assigned a C-factor of 2. At Kadena, from 1997 to 1998, among items with demand level greater than zero, there were over 6,500 more with C-factor of 2, and almost 8,000 fewer with C-factor of 1 (there were about 1,600 fewer items overall in 1998, and there were a few items with other C-factor values). The overall increase in C-factor raised the reorder point to at least 1 for most of these items. OCONUS bases are authorized a C-factor of 2 for specific (mission support) types of items. **Using a C-factor of 2 reduces backorders (85 a year at Kadena). OCONUS bases should closely monitor C-factors assigned to items**

meeting the criteria described in AFMAN 23-110, Vol II, Part Two, Chapter 19, Paragraph 19.12.4.2.

In an attempt to focus on mission critical items, we used mission impact code (MIC) 1 as a filter to select items involved. A MIC 1 identifies items backordered mission capable (MICAP) or awaiting parts (AWP-only urgency justification code AR). When we included MIC 1 as part of our selection criteria, we saw a significant reduction in number of items selected and costs involved. Results for 1998 are listed in Table 2-7.

			Method 1				***Method 2***			
				Annual Costs				**Annual Costs/Savings**		
Base	**Items**	**B/O Redu.**	**One-Time Inv. Costs(1)**	**Order Cost (DLA)(2)**	**Hold Cost(3)**	**Order Cost (Base)(4)**	**One-Time Inv. Cost(5)**	**Hold Cost(6)**	**Order Cost (Base) Savings(7)**	**DLA Surcharge Savings(8)**
Dover	609	79	$38.3K	$9.5K	$5.7K	$2.8K	$76.6K	$11.5K	($0.4K)	($1.4K)
Moody	659	72	$33.0K	$10.8K	$5.0K	$3.2K	$66.1K	$9.9K	($0.4K)	($1.3K)
Minot	183	28	$33.6K	$2.6K	$5.0K	$0.7K	$67.2K	$10.1K	($0.1K)	($0.5K)
Pope	260	49	$24.8K	$3.8K	$3.7K	$1.1K	$49.7K	$7.5K	($0.3K)	($0.9K)
Rand	296	39	$15.0K	$5.0K	$2.2K	$1.5K	$30.0K	$4.5K	($0.2K)	($0.7K)
Robins	105	19	$4.4K	$1.6K	$0.7K	$0.5K	$8.7K	$1.3K	($0.1K)	($0.3K)
Kad.	28	5	$8.5K	$0.2K	$1.3K	$50	$17.0K	$2.5K	($25)	($90)
Spang.	15	3	$1.1K	$0.2K	$0.2K	$50	$2.1K	$0.3K	($15)	($50)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Base order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-7. Non-Retention Items with ROP=0, D/L>1 and MIC=1 (1998)

The results of Table 2-7, when totaled, indicate the number of items selected decreased 55 percent (2155/4828) and the number of backorders prevented decreased 51 percent (294/606). A related decrease in average on-hand inventory cost of up to 42 percent ($158,700/$271,400) is also realized. The key point to keep in mind is that all items now selected are mission critical items. For Dover that means a possible reduction of 79 MICAP (or AWP) incidents per year.

We decided to eliminate all items that were authorized bench stock details. Because there are at least two on-base storage sites (bench stock and base supply stock) for bench stock items we don't consider them as strictly having a reorder point of zero. When base supply issues the last serviceable bench stock item off the shelf, most of the time it will be to fill a bench stock. Therefore, a bench stock will probably still have a serviceable balance when supply orders to replenishment its stock level. Table 2-8 reflects the results of the six CONUS bases. Because the numbers were so low for our two OCONUS bases (5 and 3 backorders reduced for MIC 1 items) we saw no reason to examine their data any further.

			Method 1				Method 2			
				Annual Costs				Annual Costs/Savings		
Base	Items	B/O Redu.	One-Time Inv. Costs(1)	Order Cost (DLA)(2)	Hold Cost (3)	Order Cost (Base)(4)	One-Time Inv. Cost(5)	Hold Cost(6)	Order Cost (Base) Savings(7)	DLA Surcharge Savings(8)
Dover	469	60	$35.4K	$7.4K	$5.3K	$2.2K	$70.7K	$10.6K	($0.3K)	($1.1K)
Moody	518	56	$27.3K	$8.4K	$4.1K	$2.5K	$54.6K	$8.2K	($0.3K)	($1.0K)
Minot	150	24	$32.5K	$2.1K	$4.9K	$0.6K	$64.9K	$9.7K	($0.1K)	($0.4K)
Pope	226	42	$23.2K	$3.4K	$3.5K	$1.0K	$46.4K	$7.0K	($0.2K)	($0.7K)
Rand	221	28	$12.9K	$3.8K	$1.9K	$1.1K	$25.8K	$3.9K	($0.1K)	($0.5K)
Robins	96	17	$4.0K	$1.5K	$0.6K	$0.4K	$7.9K	$1.2K	($0.1K)	($0.3K)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Base order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-8. Non-Retention, Non-Bench Stock Items with ROP=0, D/L>1 and MIC=1 (1998)

As indicated by the results in Table 2-8, we decreased the total number of items involved by 20 percent (1680/2112) (considering only CONUS data from Table 2-7) and still retained a high percentage of backorders reduced (79 percent: 227/288) when we excluded bench stock items. Inventory costs involved were reduced by only 9 percent ($135,200/$149,100), which was to be expected due to most bench stock items being relatively inexpensive.

To reduce costs involved, we narrowed our selection criteria from items with a demand level greater than 1 to items with a demand level greater than 2. Table 2-9 displays the results for the six CONUS bases.

			Method 1				Method 2			
				Annual Costs				Annual Costs/Savings		
Base	Items	B/O Redu.	One-Time Inv. Costs(1)	Order Cost (DLA)(2)	Hold Cost(3)	Order Cost (Base)(4)	One-Time Inv. Cost(5)	Hold Cost(6)	Order Cost (Base) Savings(7)	DLA Surcharge Savings(8)
Dover	373	46	$12.5K	$5.7K	$1.9K	$1.7K	$25.0K	$3.8K	($0.2K)	($0.8K)
Moody	383	40	$9.6K	$6.0K	$1.4K	$1.8K	$19.2K	$2.9K	($0.2K)	($0.7K)
Minot	108	16	$8.1K	$1.5K	$1.2K	$0.4K	$16.1K	$2.4K	($0.1K)	($0.3K)
Pope	164	31	$10.5K	$2.4K	$1.6K	$0.7K	$21.0K	$3.1K	($0.2K)	($0.5K)
Rand	195	27	$11.4K	$3.3K	$1.7K	$1.0K	$22.8K	$3.4K	($0.1K)	($0.5K)
Robins	77	13	$2.5K	$1.1K	$0.4K	$0.3K	$5.0K	$0.8K	($0.1K)	($0.2K)
TOTAL 6 BASES	1300	173	$54.6K	$20.0K	$8.2K	$5.9K	$109.1K	$16.4K	($0.9K)	($3.1K)
TOTAL CONUS	13000	1730	$545.7K	$199.6K	$81.9K	$58.6K	$1.1M	$163.7K	($9.0K)	($30.7K)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Base order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-9. Non-Retention, Non-Bench Stock Items with ROP=0, MIC=1 and DL>2 (1998)

As you can see when you compare Table 2-8 and Table 2-9, we reduced our estimated *One-Time Inventory Cost* by around 60 percent ($54.6K/$135.3K) at the six bases while only losing about 24 percent (173/227) of the backorders.

In order to compare costs for both methods, we used a 7-year Net Present Value (NPV) approach. We used 7 years because that is the average life span for stocking an item at a base. Basically, we estimate how much money the Air Force would need to have on hand now, assuming it could be invested over seven years, to pay each of the annual costs (in today's dollars) for the increased number of requisitions and for the increased annual inventory holding cost. (See Appendix B for further details). The results of our first NPV comparison are found in table 2-10.

	Method 1			*Method 2*		
Base	**One-Time Inv. Cost**	**NPV Annual DLA Surcharge**	**NPV Base Costs**	**One-Time Inv. Cost**	**NPV Annual DLA Surcharge Savings**	**NPV Base Costs**
Dover	$12.5K	$36.2K	$22.6K	$25.0K	($5.2K)	$22.4K
Moody	$9.6K	$38.3K	$20.4K	$19.2K	($4.5K)	$17.1K
Minot	$8.0K	$9.4K	$10.5K	$16.1K	($1.8K)	$14.9K
Pope	$10.5K	$15.4K	$14.5K	$21.0K	($3.5K)	$19.0K
Rand.	$11.4K	$20.9K	$17.0K	$22.8K	($3.1K)	$20.9K
Robins	$2.5K	$7.1K	$4.5K	$5.0K	($1.5K)	$4.4K
TOTALS	$54.6K	$127.3K	$89.5K	$109.1K	($19.6K)	$98.6K
TOTALS FOR 60 BASES	**$545.7K**	**$1.3M**	**$895.2K**	**$1.1M**	**($195.6K)**	**$986.4K**

Table 2-10. Net Present Value (NPV) Comparison of all Cost (Separate)

Table 2-10 shows the one-time inventory costs and the NPV of the annual costs for both methods. *Method 2* has twice the one-time inventory costs when compared to *Method 1,* and slightly higher NPV of base costs, but it results in a NPV savings for DLA surcharges. To compare total costs for both methods, we combined one-time and annual costs, using the net present value results for the annual costs, to arrive at a comparable cost for the two methods (in *Method 2*, we added the NPV holding cost and subtracted the NPV savings for reduced backorders). Results of this comparison are in Table 2-11.

			Method 1	*Method 2*
Base	**Items**	**B/O Redu.**	**7-Yr NPV**	**7-Yr NPV**
Dover	373	46	$71.3K	$42.2K
Moody	383	40	$68.4K	$31.8K
Minot	108	16	$27.9K	$29.2K
Pope	164	31	$40.4K	$36.5K
Rand.	195	27	$49.3K	$40.6K
Robins	77	13	$14.1K	$7.9K
TOTALS	1,300	173	$271.4K	$188.2K
TOTALS FOR 60 BASES	*13,000*	*1,730*	*$2.7M*	*$1.9M*

Table 2-11. NPV Comparison of all Costs (Combined)

The results of table 2-11, considering all costs, indicate *Method 2* would cost approximately $800,000 less over a 7-year period.

We made an additional comparison, that being the NPV sum of the DLA surcharge cost plus the one-time inventory cost compared to the NPV sum of all costs. We made this comparison

because the Air Force will have to program for an increase in DLA surcharge cost and one-time inventory cost, in each base's operations and maintenance (O&M) budget. The base costs (base ordering cost and base holding cost) will not require an increase in O&M funds.

	Method 1	***Method 2***
NPV of Sum of One-Time Inventory Costs, DLA Surcharges and Base Costs	$2.7M	$1.9M
NPV of Sum of One-Time Inventory Costs and DLA Surcharges Only	$1.8M	$896K

Table 2-12. NPV Comparison of Total Costs versus O&M Costs only

The results of Table 2-12 show that the O&M costs are about $1M less (for both methods) than the results including the inventory holding and local order costs. Considering only budgeting (O&M) costs, *Method 2* is still less expensive than *Method 1.*

As we were doing our calculations for the above tables, we wondered if the increase in requisitions generated by *Method 1* would be significant enough to decrease the $17.73 DLA surcharge. We multiplied the $17.73 surcharge by the current total number of Department of Defense (DOD) requisitions to DLA (approximately 20 million), added the result ($354,600,000) to the expected cost increase to DLA ($77,745 for 2.45 GS-05s to process the additional workload created by *Method 1*) and arrived at $354,677,745. We then divided $354,677,745 by 20,011,260 (the 20 million DOD requisitions plus the expected increased number of requisitions). We found that implementing *Method 1* could actually decrease the surcharge by $0.01. Therefore we compared the $17.72 surcharge results for our sample bases with the results of the $17.73 surcharge. The results are listed in Table 2-13.

Base	**Annual DLA Surcharge ($17.72)**	**7 Year NPV Annual DLA Surcharge ($17.72)**	**Annual DLA Surcharge ($17.73)**	**7 Year NPV Annual DLA Surcharge ($17.73)**
Dover	$5.67K	$36.2K	$5.67K	$36.2K
Moody	$6.01K	$38.3K	$6.01K	$38.3K
Minot	$1.47K	$9.4K	$1.47K	$9.4K
Pope	$2.41K	$15.4K	$2.41K	$15.4K
Rand.	$3.28K	$21.0K	$3.28K	$20.9K
Robins	$1.12K	$7.1K	$1.12K	$7.1K
TOTALS FOR 6 BASES	$19.95K	$127.2K	$19.96K	$127.3K
TOTALS FOR CONUS	**$199.53K**	**$1.272M**	**$199.64K**	**$1.273M**
SAVINGS ON CURRENT REQUISITIONS (4M)	**($40K)**	**($255K)**	**-**	**-**
NET ANNUAL COST	**$159.53K**	**$1.017M**	**$199.64K**	**$1.273M**

Table 2-13. NPV Comparison of $17.72 DLA Surcharge versus $17.73 DLA Surcharge

As you can see in Table 2-13, the $17.72 surcharge reduced the annual cost of implementing *Method 1* by slightly more than $40,000. This is due not only to the reduced cost for the

increased requisitions created by *Method 1*, but also to the reduced cost for the current approximately 4 million annual requisitions the Air Force submits to DLA, which yields an additional annual $40,000 savings in DLA surcharges. This totals to approximately $40.1K annual savings compared to the $17.73 surcharge for *Method 1*. Expressed in terms of 7-year net present values, the reduced surcharge saves $255K on the current Air Force requisitions, and about $1K more on the increased requisitions.

This reduction in costs for *Method 1* still does not make it less expensive, over the 7-year net present value period, than *Method 2*. **Total one-time and NPV costs for *Method 1* amount to $2.46M, including base costs, which are still $576K more expensive than *Method 2*.** Considering only budget costs, the 7-year NPV costs for *Method 1* declines to about $1.56M, which is still $667K more than *Method 2*. **Clearly, *Method 2* is the most cost-effective method of increasing the reorder point.**

Using *Method 2* to increase the reorder point, we estimated a reduction of 13 to 46 MICAP backorders at each **CONUS** base per year (average of 28.8) at what amounts to an average **one-time inventory cost** of approximately $18.2K per base and an average **annual surcharge savings** of $500 per base. Additionally, annual non-budget expenses (**base costs**) would average approximately $16.4K per base. There would be little or no impact at overseas bases.

It is obvious that increasing the reorder point from zero to one on non-retention, non-bench stock, XB3 items, which have a demand level greater than two and a mission impact code of 1 would be beneficial in terms of reducing MICAP backorders (approximately 1,730 CONUS wide). **However, it is our opinion that the cost of making such a change are too high when compared to the expected benefits.** Three additional factors to consider, which weigh against making this change are: 1) the backorder reductions only accrue at CONUS bases. Since the MICAP order and ship time within CONUS is less than 5 or 6 days, the length of a backorder should not be very long; 2) seamless supply initiatives include a review of stockage formulas for improvement opportunities; and 3) efforts required to make SBSS software changes necessary are, at this stage (considering future implementation of Integrated Logistics System-Supply (ILS-S) System), probably better utilized addressing more critical SBSS problems. Considering all of the above, we recommend the SBSS reorder point continue to be calculated using the current formula.

WHOLESALE AND RETAIL RECEIVING/SHIPPING SYSTEM (D035K)

In the second part of our analysis, we looked at XB3 items in the Wholesale and Retail Receiving/Shipping System (D035K) which had a reorder point of zero and a positive demand level. We used June 1996 data from two of the five Air Force Logistics Centers (Warner Robins (WR-ALC) and Oklahoma City (OC-ALC)). Our D035K analysis is similar to our SBSS analysis with one exception. After identifying items with a reorder point of zero, we applied a soon to be implemented D035K stockage policy which is the result of a proposal made by the AFLMA in a previous project. This policy splits candidate items into two categories: those which are reordered using a lotsize, or order on demand approach and those which use the EOQ determination for the reorder quantity. For the former, we increased the reorder quantity by 1 on only the next order, and subsequently reorder the lotsize amount when stock on hand reaches 1, rather than 0. For the latter (EOQ), we did the same if the EOQ quantity is 1, or we reduced the

EOQ amount by 1, while retaining the same demand level, which effectively increases the reorder point by 1 (this increases the frequency of reordering). We refer to this policy as *Method 1D (depot)*. This composite lot size policy is an Air Force Material Command (AFMC) directed "compromise" policy to alter ordering frequencies of consumable items in an effort to increase DLA support to AFMC. The compromise policy is further defined in Appendix A. The alternative approach, *Method 2D*, is simply to order one more item, one time, and then return to the existing order quantity. That is, increase the reorder point and the demand level by 1.

Again, throughout the following tables, we exclusively used *Method 1D* as a tool to gauge the effectiveness of the filters we applied. After summarizing the results of the last filter (Table 2-19), we compared *Method 1D* to *Method 2D* to determine which is more cost effective. One change from our cost calculations for the SBSS (base) analysis is that we only assign DLA surcharges to those items which are flagged in the item data base as not being *co-located* at the ordering depot. DLA does not assess a surcharge to those items which DLA stocks at the ordering depot, (flagged as being *co-located)* since they simply enter a computer transaction to transfer ownership from DLA to the depot. Therefore, these items are not charged handling, packaging, or shipping cost.

First we looked at items with a reorder point equal to zero and a customer order size (lot size, LS) greater than or equal to one. We compared those numbers to items with a reorder point of zero and a lot size greater than one. Table 2-14 shows this comparison for WR-ALC. Results indicate items with a reorder point of zero and a lot size greater than or equal to one would reduce the number of expected backorders by 926 at an estimated one-time inventory cost of $1.1 million. By selecting only items with a reorder point of zero and a lot size greater than one we reduced the cost involved by more than 90 percent ($98K/$1.1M) and managed to still prevent 42 percent of the backorders (392/926). We considered a policy which included increasing the reorder point on items with a lot size equal to one too costly for the benefits it provides. Therefore, we eliminated items with a lot size of one from the rest of our analysis of D035K data. We had similar results for OC-ALC (Table 2-15).

			Method 1D				***Method 2D***			
			Annual Costs				**Annual Costs/Savings**			
	Items	**B/O Red.**	**One-Time Inv. Costs(1)**	**DLA Surcharge(2)**	**Holding Cost(3)**	**Order Cost (Depot)(4)**	**One- Time Inv. Costs(5)**	**Holding Cost(6)**	**Depot Order Cost Savings(7)**	**DLA Surcharge Savings(8)**
LS>=1	3,281	926	$1.1M	$11.4K	$170.9K	$3.3K	$1.2M	$175.4K	($3.7K)	($12.6K)
LS>1	1,113	392	$98.1K	$5.4K	$14.7K	$1.6K	$108.7K	$16.3K	($1.6K)	($5.5K)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Depot order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-14. Comparison of Items with ROP=0 and LS>=1 to Items with ROP=0 and LS>1 at WR-ALC

			Method 1D				Method 2D			
			Annual Costs				Annual Costs/Savings			
	Items	B/O Red.	One-Time Inv. Costs(1)	DLA Surcharge(2)	Holding Cost(3)	Order Cost (Depot)(4)	One- Time Inv. Costs(5)	Holding Cost(6)	Depot Order Cost Savings (7)	DLA Surcharge Savings(8)
LS>=1	4,021	1203	$1.3M	$9.8K	$197.7K	$2.9K	$1.4M	$208.9K	($4.5K)	($15.2K)
LS>1	1,377	548	$164K	$4.6K	$24.7K	$1.4K	$220.8K	$33.1K	($2.3K)	($7.7K)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Depot order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-15. Comparison of Items with ROP=0 and LS>=1 to Items with ROP=0 and LS>1 at OC-ALC

To determine if we could achieve most of the benefits (reduced backorders) at less cost, we added a unit price filter. In Tables 2-16 and 2-17, we compared the expected cost to the number of backorders prevented.

			Method 1D				Method 2D			
			Annual Costs				Annual Costs/Savings			
	Items	B/O Red.	One-Time Inv. Costs(1)	DLA Surcharge (2)	Holding Cost(3)	Order Cost (Depot)(4)	One-Time Inv. Costs(5)	Holding Cost(6)	Order Cost (Depot) Savings (7)	DLA Surcharge Savings(8)
Unlimited	1113	392	$98.1K	$5.4K	$14.7K	$1.6K	$108.7K	$16.3K	($1.6K)	($5.5K)
<=$10K	1112	392	$83.4K	$5.4K	$12.5K	$1.6K	$94.0K	$14.1K	($1.6K)	($5.5K)
<=$5K	1111	392	$77.9K	$5.4K	$11.7K	$1.6K	$88.5K	$13.3K	($1.6K)	($5.5K)
<=$1K	**1092**	**355**	**$35.5K**	**$5.7K**	**$5.3K**	**$1.7K**	**$43.4K**	**$6.5K**	**($1.5K)**	**($5.0K)**
<=$500	1074	328	$26.6K	$5.2K	$4.0K	$1.5K	$31.9K	$4.8K	($1.3K)	($4.5K)
<=$250	1042	307	$17.0K	$5.0K	$2.5K	$1.5K	$21.2K	$3.2K	($1.2K)	($4.3K)
<=$100	985	274	$9.2K	$4.9K	$1.4K	$1.4K	$12.2K	$1.8K	($1.1K)	($3.8K)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Depot order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-16. Cost Filter for WR-ALC for Items with LS>1

			Method 1D				*Method 2D*			
			Annual Costs				**Annual Costs/Savings**			
	Items	**B/O Red.**	**One-Time Inv. Costs(1)**	**DLA Surcharge (2)**	**Holding Cost(3)**	**Order Cost (Depot)(4)**	**One-Time Inv. Costs(5)**	**Holding Cost(6)**	**Order Cost (Depot) Savings(7)**	**DLA Surcharge Savings(8)**
Unlimited	1377	548	$164.4K	$4.6K	$24.7K	$1.4K	$220.8K	$33.1K	($2.3K)	($7.7K)
<=$10K	1376	547	$127.1K	$4.6K	$19.1K	$1.4K	$146.3K	$21.9K	($2.3K)	($7.7K)
<=$5K	1373	545	$107.7K	$4.6K	$16.2K	$1.4K	$126.9K	$19.0K	($2.2K)	($7.7K)
<=$1K	**1347**	**520**	**$57.0K**	**$4.6K**	**$8.6K**	**$1.4K**	**$72.2K**	**$10.8K**	**($2.1K)**	**($7.3K)**
<=$500	1319	487	$38.9K	$4.6K	$5.8K	$1.4K	$51.8K	$7.8K	($2.1K)	($7.0K)
<=$250	1271	440	$26.1K	$3.4K	$3.9K	$1.0K	$34.8K	$5.2K	($1.9K)	($6.3K)
<=$100	1163	367	$12.2K	$3.1K	$1.8K	$0.9K	$17.6K	$2.6K	($1.5K)	($5.2K)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Depot order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-17. Cost Filter for OC-ALC for Items with LS>1

Numbers from WR-ALC (Table 2-16) led us to think the category including items with a unit price equal to or less than $1,000 would be the most effective for the cost incurred. The results from OC-ALC data (Table 2-17) validated our thoughts. Note for WR-ALC (*Method 1D*), items with a unit price less than or equal to $1,000 achieved 91 percent (355/392) of the backorder reduction (when compared to items without a unit price filter) at 36 percent ($35.5K/$98.1K) of the cost. OC-ALC results were even better, 95 percent (520/548) backorder reduction at 35 percent ($57K/$164.4K) of the cost.

Although associated costs continue to decline by lowering the unit price filter, we concluded the $1,000 filter provides the more effective method. When compared to the $5,000 filter for OC-ALC, the $1,000 filter reduced prevented backorders by only 25, yet cost $50.7K less. Using a "marginal cost" approach, this equates to about $2,000 per backorder to prevent the additional 25 backorders by staying at the more costly $5,000 filter. Comparing the $1,000 filter to the $500 filter shows the $500 filter reduces cost by only $18.1K but decreases the prevented backorder total by 33. The additional 33 backorders can be prevented at a cost of only $18.1K or $550 per backorder by staying at the $1,000 filter. We think this is a reasonable investment. Similar results can be seen for the WR-ALC data. **Thus, the $1,000 filter prevents the largest number of backorders for a reasonable price.**

Along with the unit price less than or equal to $1,000 filter, we added a daily demand rate (DDR) filter with the lot size greater than or equal to one filter and lot size greater than one filter. We

separated the results into five categories for comparison. Table 2-18 (WR-ALC) and Table 2-19 (OC-ALC) display the results.

			Method 1D				***Method 2D***			
			Annual Costs				**Annual Costs/Savings**			
	Items	**B/O Red.**	**One-Time Inv. Costs(1)**	**DLA Surcharge (2)**	**Holding Cost(3)**	**Order Cost (Depot)(4)**	**One-Time Inv. Costs(5)**	**Holding Cost(6)**	**Order Cost (Depot) Savings(7)**	**DLA Surcharge Savings(8)**
LS>1	1092	355	$35.5K	$5.7K	$5.3K	$1.7K	$43.4K	$6.5K	($1.5K)	($5.0K)
LS>=1 & DDR>0.010	1983	713	$150.0K	$7.3K	$22.5K	$2.2K	$166.4K	$25.0K	($2.9K)	($9.8K)
LS>=1 & DDR>0.012	1665	636	$109.9K	$6.5K	$16.5K	$1.9K	$123.8K	$18.6K	($2.6K)	($8.8K)
LS>1 & DDR>0.010	**1064**	**353**	**$34.6K**	**$5.4K**	**$5.2K**	**$1.6K**	**$42.4K**	**$6.4K**	**($1.5K)**	**($5.0K)**
LS>1 & DDR>0.012	995	338	$27.6K	$5.3K	$4.1K	$1.6K	$35.2K	$5.3K	($1.4K)	($4.8K)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory
(6) Holding cost--15% of inventory cost
(7) Depot order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings

Table 2-18. Comparison of DDRs and LS (WR-ALC)

			Method 1D				***Method 2D***			
			Annual Costs				**Annual Costs/Savings**			
	Items	**B/O Red.**	**One-Time Inv. Costs(1)**	**DLA Surcharge (2)**	**Holding Cost(3)**	**Depot Order Cost(4)**	**One-Time Inv. Costs(5)**	**Holding Cost(6)**	**Depot Order Cost Savings(7)**	**DLA Surcharge Savings(8)**
LS>1	1347	520	$57.0K	$4.6K	$8.6K	$1.4K	$72.2K	$10.8K	($2.1K)	($7.3K)
LS>=1 & DDR>0.010	2421	959	$205.1K	$4.9K	$30.8K	$1.4K	$229.1K	$34.4K	($3.7K)	($12.6K)
LS>=1 & DDR>0.012	1994	863	$148.2K	$3.8K	$22.2K	$1.1K	$169.2K	$25.4K	($3.4K)	($11.5K)
LS>1 & DDR>0.010	**1304**	**515**	**$52.4K**	**$4.3K**	**$7.9K**	**$1.3K**	**$67.3K**	**$10.1K**	**($2.1K)**	**($7.3K)**
LS>1 & DDR>0.012	1233	504	$46.3K	$4.0K	$6.9K	$1.2K	$60.9K	$9.1K	($2.1K)	($7.1K)

(1) One-time increase in inventory cost
(2) DLA ordering cost--$17.73 per-order surcharge from DLA
(3) Holding cost--15% of inventory cost
(4) Base ordering cost--$5.20 per order
(5) Increase in demand level generates a one-time increase in inventory

(6) Holding cost--15% of inventory cost
(7) Depot order cost savings--$5.20 per eliminated backorder; ( ) indicate savings
(8) DLA surcharge savings--$17.73 per eliminated backorder; ( ) indicate savings
Table 2-19. Comparison of DDRs and LS (OC-ALC)

The results of Tables 2-18 and 2-19 indicate using a policy with an additional filter of DDR greater than 0.010, along with the unit price less than or equal to $1,000 and LS greater than 1, reduces one-time cost involved by $900 at WR-ALC and $4.6K at OC-ALC. This reduction in cost is offset by a corresponding reduction in preventable backorders of only 2 at WR-ALC and 5 at OC-ALC. Using our previous "marginal cost" approach, this would equate to $450 per additional backorder prevented at WR-ALC by not using the additional DDR > 0.010 filter, but about $900 per additional backorder at OC-ALC. While at WR-ALC there is no significantly greater cost to not using the additional DDR filter, there is at OC-ALC. **Therefore, we believe increasing the reorder point from zero to one for items with a lot size greater than 1, a daily demand rate greater than 0.010, and a unit cost of less than $1,000 yields the best results.**

Next, we determined which method should be used to increase the reorder point. We used the Net Present Value method (as used earlier to compare SBSS methods). Table 2-20 shows the results of our comparison.

			Method 1D	***Method 2D***
Base	**Items**	**B/O Redu.**	**7-Yr NPV**	**7-Yr NPV**
WR-ALC	1064	353	$112.5K	$42.0K
OC-ALC	1304	515	$138.0K	$71.5K
TOTALS	***2368***	***868***	***$251K***	***$114K***

Table 2-20. Comparison of Net Present Value (All Costs) WR-ALC and OC-ALC

Considering all costs (inventory, ordering and holding costs), *Method 2D* ($114K) cost less than *Method 1D* ($251K). Therefore we recommend using *Method 2D* to increase the reorder point because it has the least expensive 7-year NPV.

We estimated how implementing this policy would effect all five D035K systems in AFMC. Combined, Robins and Oklahoma City account for 43 percent of AFMC's total requisitions for XB3 budget code 9 items from DLA. They also account for over 63 percent of the dollar value of XB3 budget code 9 items purchased by AFMC from DLA. Therefore, we thought by adding the numbers from the two largest centers and doubling the results we would arrive at a fair estimate of the total implementation costs and of the backorders reduced across all five Air Logistics Centers. These results are displayed in Table 2-21.

			Method 1D	***Method 2D***
	Items	**B/O Redu.**	**7-Yr NPV**	**7-Yr NPV**
AFMC TOTALS	***4736***	***1736***	***$501K***	***$227K***

Table 2-21. Comparison of Net Present Value (All Costs), AFMC Totals

Table 2-21 shows *Method 2D* is approximately 65 percent less expensive than *Method 1D*. Again, we made one final comparison, that being the NPV sum of the DLA surcharge cost plus the one-time inventory cost compared to the NPV sum of all costs. We made this comparison because the Air Force will have to program for the increase in DLA surcharge cost and one-time inventory cost in each Air Logistics Center's operations and maintenance (O&M) budget. The depot ordering cost and holding cost will not require an increase in O&M funds. We used the results of Table 2-22 as the basis of our recommendation.

	Method 1D	***Method 2D***
NPV of Sum of One-Time Inventory Costs, DLA Surcharges and Base Costs	$501K	$227K
NPV of Sum of One-Time Inventory Costs and DLA Surcharges Only	$298K	$63K

Table 2-22. NPV Comparison of Total Costs versus O&M Costs only

Therefore, we recommend using *Method 2D* to increase the reorder point from zero to one on D035K items with a lot-size greater than one, DDR greater than 0.010 and a unit cost of less than or equal to $1,000. **Bottom line, our proposed reorder policy will reduce almost 1,740 depot retail backorders annually at a 7-year net present value cost (expected increase in operations and maintenance costs) of approximately $63K.**

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CHAPTER 3

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS:

1. OCONUS bases can reduce their number of backorders by ensuring eligible item records are assigned a C-factor of two.

2. By increasing the reorder point from zero to one on only non-retention, non-bench stock, XB3 items, which have a demand level greater than two and a mission impact code of 1, Standard Base Supply Systems at 60 CONUS bases can potentially reduce a total of over 1,700 MICAP backorders annually. The 7-year net present value cost (expected increase in base operations and maintenance costs only) would be approximately $896K, or $15K per base. We believe this cost is too high when compared to the expected benefits.

3. Depot retail systems (D035K) can reduce nearly 1,740 backorders by increasing the reorder point from zero to one on XB3 items which have an average customer order size (lot size) greater than one, a daily demand rate greater than 0.010 and a unit price less than or equal to $1,000. The 7-year net present value cost (expected increase in base operations and maintenance costs only) for all Air Logistics Centers is estimated at $63K.

RECOMMENDATIONS:

1. OCONUS bases ensure eligible items are assigned a C-factor of two. (REF: AFMAN 23-2110, Volume II, Part Two, Chapter 19, Paragraph 19.12.4.2.)
   OPR: HQ USAFE/LGS and HQ PACAF/LGS

2. Continue to use the current SBSS reorder point formula.

3. Program D035K to increase the reorder point from zero to one on XB3 items with a lot size greater than 1, daily demand rate greater than 0.010, and unit price less than or equal to $1000 using *Method 2D* (increase the demand level by one which in-turn increases the reorder point to one).
   OPR: HQ AFMC/LGS

<u>DISTRIBUTION</u>: Refer to attached Standard Form 298.

APPENDIX A

AFLMA Compromise Proposal

The proposed compromise lot size approach for the Air Force depots, explained in AFLMA Project LS199718904, is as follows (Step 2 applies to this project):

Step 1: For the following items:
- Positive Demand Level
- DLA supported (RID = S9x)
- ERRC = N
- Budget Code = 9
- Acquisition Advice Code (AAC) = D, H, J, or Z:

For all AAC = Z and AAC = J items, and for those AAC = D or H items with at least 4 units demanded per year and with average EOQ requisition (stock replenishment) dollar value (REQVAL) greater than $125.00:
- Set the order quantity to the demand quantity
- Set the reorder point to 60 days of demand

Otherwise, for the remaining AAC = D or H items, order the EOQ and:
- For those with Daily Demand Rate (DDR) at least 0.008 and with Unit Price (UP) less than $50.00, set the C-factor to 2.5 to calculate safety level
- Otherwise (DDR less than 0.008 or UP greater than or equal to $50.00), set the C-factor to 1.5 to calculate safety level

Step 2: For the following items:
- Positive Demand Level
- ERRC=N
- Budget Code=9
- Reorder Point=0

If the lotsize is greater than 1, the unit price is less than or equal to $1,000.00, and the daily demand rate is greater than 0.010, then increase the ROP to 1 and order one additional item on the next order (1 plus the lot size or 1 plus the EOQ).

- For items ordering on demand, increasing the reorder point will not affect future ordering quantities (i.e., order the last demanded quantity).
- For items using EOQ ordering policy, increase the DL by 1, thereby future orders will be for the EOQ amount.

APPENDIX B

Analysis Methodology

The validity of our analysis and recommendations is dependent upon using appropriate data and acceptable methodologies. Thus, to support our results, the following text outlines the data and analysis approach we used.

Data

We analyzed data for both base-level and depot-level accounts. For the base-level analysis we used March 1997 and March 1998 item record data from six CONUS bases and two OCONUS bases. We selected only records for expendable items (ERRC = XB3) from primary supply accounts which had a positive demand level for the period. Since the item record data does not contain an order and ship time (O&ST) value, we used default values of 15 days for the two CONUS bases and 53 days for the two OCONUS bases. These were the average values derived from an analysis of order and ship time in an earlier AFLMA study (LS199605310).

For the depot analysis, we used June 1996 retail account data for Warner Robins and Oklahoma City ALCs extracted from the D035K system for a previous project. We selected only records for expendable items (ERRC = N) which were budget code 9 and had a positive stock level. We used O&ST data, when valid, from the D035K record. When not valid, we used 9 (the average over all records with valid entries).

Analysis

To estimate the effect of an item having a reorder point (ROP) of zero we needed to determine which items have a reorder point of zero. Since the depots are in the process of changing policy (per AFLMA Report LS199718904), we modeled the ROP, which is calculated one of two different ways, based on the AFMC directed "compromise" policy. If the item met the selection criteria for being an order-on-demand item, the demand level would be calculated as 60 days of demand (60*ddr), and the reorder point would be one less than the demand level. That is, place an order whenever on-hand stock is less that the 60-day demand level.

Otherwise, the item would be ordered under the EOQ approach, so we emulated the system calculation of EOQ ROP by first calculating a demand level,

$$DLcalc = TRUNC(EOQ + OST \times ddr + SL + 0.999)$$

where EOQ is the usual Economic Order Quantity, ddr is the daily demand rate, and SL is the computed safety level, and then setting

$$ROP = DLcalc - TRUNC(EOQ + 0.999)$$

(TRUNC(XXX + 0.999) rounds up XXX to the next highest whole number.) Using the appropriate ROP calculation (per AFLMA Report LS199718904), we then selected all items for which ROP calculated as 0.

Having selected this subset for our analysis, we estimated the probability of backorders during the replenishment period (order and ship time) by using the cumulative Poisson probability distribution of order frequency $P(n,\alpha t)$ with parameters n = number of units ordered, α = the daily demand rate, and t = the order and ship time in days. Since the first demand generates the replenishment requisition and starts the O&ST period, when ROP = 0, 1 or more additional demands (n = 2) during the O&ST period will cause a backorder(s). If the ROP were raised to 1, then 2 or more additional demands (n = 3) during the order and ship time period would cause a backorder(s).

We also estimated the expected number of backorders during an O&ST period, when ROP = 0, by estimating the infinite sum

$$E(BO:ROP=0)=\sum_{i=1}^{\infty}(i)p(i,\alpha t)$$

where $p(i,\alpha t)$ is the Poisson probability distribution (not cumulative probability) of i additional orders during the O&ST period of length t when DDR = α (each of which would be a backorder, since ROP=0).

When ROP = 1, the first order during an O&ST period would reduce stock to 0 and only a second, and subsequent orders during the O&ST period would cause a backorder situation. Thus,

$$E(BO:ROP=1)=\sum_{i=2}^{\infty}(i-1)p(i,\alpha t)$$

Finally, we estimated the annual expected number of backorders by multiplying the calculated expected number of backorders by the lesser of either the annual demand rate or the maximum number of disjoint O&ST periods in a year. (If the annual demand rate is greater than the maximum number of disjoint O&ST periods in a year, then some of those demands occur in an existing O&ST period, and are counted in the expected number of orders and backorders in that period.)

To estimate the benefit and cost of a policy to increase the reorder point, we estimated, for each NSN with calculated ROP of 0, the expected annual number of backorders reduced by increasing ROP to 1 by taking the difference of the annual expected number of backorders for ROP = 0 and for ROP =1:

$$E(BO:ROP=0)-E(BO:ROP=1)$$

The cost of achieving this expected reduction in backorders depends on the approach used. We modeled combinations of two different approaches:

- Decreasing the usual order quantity by 1, without changing the demand level.
- Increasing the demand level by 1; this would be a one-time inventory increase,

The first approach increases the ROP since the demand stays the same while the order quantity decreases. The cost of this approach is the sum of both one-time and annual costs:

- the increased average on-hand inventory, which is one-half unit on average. Average inventory is one-half the order quantity plus the safety level. We have effectively increased the safety level by one, but decreased the average inventory on-hand (above reorder point) by one-half, for a net increase of one-half unit. This gives a one-time cost of one-half the unit price.
- the increased frequency of orders placed, which we assess at both the DLA surcharge and the base cost to place an order. We decreased the order quantity by one, so we order more frequently (Once again, we assume no significant increase in warehouse facility or manpower costs.) These are annual costs.
- the holding cost for the increased inventory, which is estimated as 15% of the value of the additional items. This is also an annual cost.

The second approach increases ROP to 1 since we have increased the demand level by 1. The cost of this approach is basically the one-time cost of the one additional item ordered and the annual holding cost for the additional inventory, assessed at 15% of the value of the additional inventory. Since backorders are reduced, there is a decrease in the number of orders processed, which leads to a savings of both the local cost to generate the order (assessed at $5.20 per order), and the DLA surcharge per order processed (assessed at the current $17.73 per requisition).
In order to compare the costs of the two methods, we must combine one-time and annual costs. We do this by using a "net present value" approach over a seven-year time span (the average time to retain an item in base inventory). This approach computes the net present value of each of the seven years' annual expenditures by converting the annual cost in each future year to the amount the Air Force must have today that could be invested and grow to the desired amount in the future year. The Defense Department annually publishes factors to use in such a calculation, and one multiplies the "future" expenditure by the appropriate factor. We add the one-time cost to the net present value of the annual costs to estimate a single cost. We cumulate these costs for each NSN, depending on which policy we apply to each item, and compare them for different situations (policies and bases/depots).

Finally, we analyzed various subsets of ROP=0 items which also had unit price less than specified values and/or daily demand rates greater than selected values. We did this to try to reduce cost without significantly increasing backorders.

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC 20330

Office Of The Secretary

12 May 1999

MEMORANDUM FOR AFLMA/LGS

FROM: SAF/PAS
1690 Air Force Pentagon
Washington DC 20330-1690

SUBJECT: Project LS199718901 - XB3 Items with a Positive Demand Level and Reorder Point of Zero Study

Subject paper has been reviewed by the Department of the Air Force and is cleared, as amended, for public release.

The Distribution Statement on front page of the report and on the SF 298 must be changed to Distribution Statement A.

Linda Hughes
LINDA M. HUGHES
Review Officer, Office for Security Review
Office of Public Affairs

Attachment:
SAF/PAS 99-397 (Disks 9)

B043426

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Completed
2-8-2000
B.W.